NI Vision

NI CVS-1459RT User Manual

Compact Vision System with USB3 Vision and Reconfigurable I/O

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While this hardware is compliant with the applicable regulatory EMC requirements, there is no guarantee that interference will not occur in a particular installation. To minimize the potential for the hardware to cause interference to radio and television reception or to experience unacceptable performance degradation, install and use this hardware in strict accordance with the instructions in the hardware documentation and the DoC[1].

If this hardware does cause interference with licensed radio communications services or other nearby electronics, which can be determined by turning the hardware off and on, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient the antenna of the receiver (the device suffering interference).
- Relocate the transmitter (the device generating interference) with respect to the receiver.
- Plug the transmitter into a different outlet so that the transmitter and the receiver are on different branch circuits.

Some hardware may require the use of a metal, shielded enclosure (windowless version) to meet the EMC requirements for special EMC environments such as, for marine use or in heavy industrial areas. Refer to the hardware's user documentation and the DoC[1] for product installation requirements.

When the hardware is connected to a test object or to test leads, the system may become more sensitive to disturbances or may cause interference in the local electromagnetic environment.

Operation of this hardware in a residential area is likely to cause harmful interference. Users are required to correct the interference at their own expense or cease operation of the hardware.

Changes or modifications not expressly approved by National Instruments could void the user's right to operate the hardware under the local regulatory rules.

Caution To ensure the specified EMC performance, operate this product only with shielded cables and accessories.

[1] The Declaration of Conformity (DoC) contains important EMC compliance information and instructions for the user or installer. To obtain the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

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About This Manual

This manual contains detailed electrical and mechanical information for the National Instruments CVS-1459RT.

Conventions

The following conventions appear in this manual:

This icon denotes a note, which alerts you to important information.

This icon denotes a caution, which advises you of precautions to take to avoid injury, data loss, or a system crash.

When this symbol is marked on a product, it denotes a warning advising you to take precautions to avoid electrical shock.

bold — Bold text denotes items that you must select or click in the software, such as menu items and dialog box options. Bold text also denotes parameter names.

italic — Italic text denotes variables, emphasis, a cross-reference, or an introduction to a key concept. Italic text also denotes text that is a placeholder for a word or value that you must supply.

`monospace` — Text in this font denotes text or characters that you should enter from the keyboard, sections of code, programming examples, and syntax examples. This font is also used for the proper names of disk drives, paths, directories, programs, subprograms, subroutines, device names, functions, operations, variables, filenames, and extensions.

`monospace italic` — Italic text in this font denotes text that is a placeholder for a word or value that you must supply.

Related Documentation

The following documents contain information that you may find helpful as you read this manual:

- *NI CVS-1459RT Specifications*—Contains detailed specifications for the NI CVS-1459RT.
- *NI CVS-1459RT Getting Started Guide*—Explains how to install and configure the software necessary to use the NI CVS-1459RT, and how to get started using the NI CVS-1459RT hardware.
- *NI CVS I/O Accessory User Manual*—Contains installation and operation instructions for the CVS I/O Accessory.

Resources for NI Vision Builder AI Users

Refer to the *NI Vision Builder for Automated Inspection Tutorial* to learn how to perform basic machine vision techniques using Vision Builder AI. You can access the *NI Vision Builder for Automated Inspection Tutorial* and other documentation by selecting **Start»All Programs» National Instruments»Vision Builder AI»Documentation**. You can also access context help within Vision Builder AI by clicking the **Show Context Help** button on the Vision Builder AI toolbar.

Examples of common Vision Builder AI inspections are installed to the `<Vision Builder AI>\Examples` directory, where `<Vision Builder AI>` is the location Vision Builder AI is installed.

NI Vision Builder for Automated Inspection: Configuration Help—Contains information about using the Vision Builder for Automated Inspection Configuration Interface to create a machine vision application.

NI Vision Builder for Automated Inspection: Inspection Help—Contains information about running applications created with Vision Builder for Automated Inspection in the Vision Builder Automated Inspection Interface.

Resources for NI LabVIEW, NI Vision Development Module, and NI Vision Acquisition Software Users

Documentation for LabVIEW, the LabVIEW Real-Time Module, and the LabVIEW FPGA Module is available from the **Help** menu on the LabVIEW toolbar. You can access documentation for the NI Vision Development Module by selecting **Start»All Programs» National Instruments»Vision»Documentation»NI Vision**.

Documentation for the NI-IMAQdx driver software is available by selecting **Start» All Programs»National Instruments»Vision»Documentation»NI-IMAQdx**.

Documentation for the NI-IMAQ I/O driver software is available by selecting **Start» All Programs»National Instruments»Vision»Documentation»NI-IMAQ IO**.

Documentation for the MAX configuration software is available from the **Help** menu on the MAX toolbar. Specific information about using MAX with NI Vision hardware is available by selecting **Help»Help Topics»NI Vision»NI-IMAQdx**.

National Instruments Example Finder—LabVIEW contains an extensive library of VIs and example programs. To access the NI Example Finder, open LabVIEW and select **Help»Find Examples**.

Visit the NI Developer Zone at `ni.com/zone` for the latest example programs, tutorials, technical presentations, and a community area where you can share ideas, questions, and source code with developers around the world.

1

NI CVS-1459RT Overview

This chapter provides an overview of the features and components of the National Instruments CVS-1459RT Compact Vision System.

About the NI CVS-1459RT

The NI CVS-1459RT is a real-time imaging system that acquires, processes, and displays images from USB3 Vision cameras. The NI CVS-1459RT also provides multiple digital input/output (I/O) options for communicating with external devices to configure and start an inspection and to indicate results.

An Ethernet connection between the NI CVS-1459RT and a development computer allows you to display measurement results and status information and to configure the NI CVS-1459RT settings. When configured, the NI CVS-1459RT can run applications without a connection to the development computer.

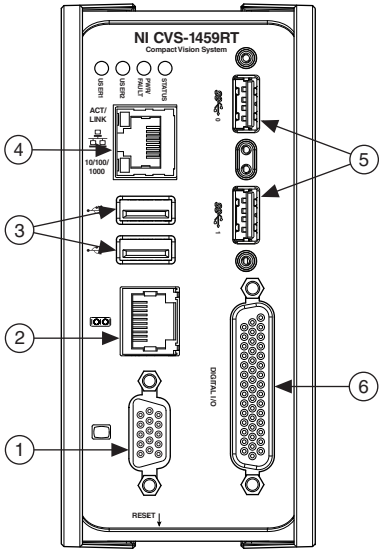
Hardware Overview

The NI CVS-1459RT front panel consists of a VGA connector, RJ50 serial port, two USB 2.0 ports, a 10/100/1000 Ethernet connector, and two USB3 Vision ports.

The NI CVS-1459RT front panel also includes LEDs for communicating system status and a 44-pin Digital I/O port. The Digital I/O port offers 8 isolated inputs, 8 isolated outputs, 2 bidirectional differential I/O (RS-422) or single-ended input lines that can be used with a quadrature encoder, and 8 bidirectional TTL lines.

Figure 1-1 shows the NI CVS-1459RT front panel connectors.

Figure 1-1. NI CVS-1459RT Front Panel Connectors



1 VGA Connector	4 RJ45 Gigabit Ethernet Network Port
2 RJ50 Serial Port	5 USB3 Vision Ports
3 USB 2.0 Ports	6 44-pin Digital I/O Connector

Software Overview

Developing machine vision applications with the NI CVS-1459RT requires one of the following software options:

- NI Vision Builder for Automated Inspection (Vision Builder AI) 2014 or later
- LabVIEW 2014 or later; LabVIEW Real-Time 2014 or later; the NI Vision Development Module 2014 or later; and NI-IMAQdx 14.0 or later driver software, included with NI Vision Acquisition Software August 2014

The NI CVS-1459RT has a user-reconfigurable FPGA that allows the I/O to be configured for particular applications. Different configurations are referred to as hardware personalities, and are defined by bitfiles. Use the following software to use and reconfigure the FPGA I/O.

- LabVIEW FPGA Module 2012 or later—You must install the LabVIEW FPGA Module to reconfigure the default personality of the NI CVS-1459RT FPGA.
- NI-IMAQ I/O 14.0 or later driver software, included with NI Vision Acquisition Software August 2014—NI-IMAQ I/O is required to use the default personality of the NI CVS-1459RT in LabVIEW, or to reconfigure the default personality of the NI CVS-1459RT I/O in the LabVIEW FPGA Module.

The installation and configuration process for each development environment is different. Refer to the *NI CVS-1459RT Getting Started Guide* for installation and configuration instructions.

The following sections describe the software options. For detailed information about individual software packages, refer to the documentation specific to the software.

NI Vision Builder for Automated Inspection

Vision Builder AI is configurable machine vision software that you can use to prototype, benchmark, and deploy machine vision applications. Creating applications in Vision Builder AI does not require programming. It also allows you to easily configure and benchmark a sequence of visual inspection steps, as well as deploy the visual inspection system for automated inspection. With Vision Builder AI, you can perform powerful visual inspection tasks and make decisions based on the results of individual tasks. You can also migrate your configured inspection to LabVIEW, extending the capabilities of your applications if necessary. Vision Builder AI allows you to remotely configure and control the NI CVS-1459RT.

LabVIEW

LabVIEW is a graphical programming environment for developing flexible and scalable applications.

LabVIEW Real-Time Module

The LabVIEW Real-Time Module combines LabVIEW graphical programming with the power of real-time (RT) hardware, such as the NI CVS-1459RT, enabling you to build deterministic, real-time systems. You develop VIs in LabVIEW and embed the VIs on RT targets. For more information about the LabVIEW Real-Time Module, refer to the *LabVIEW Help*.

LabVIEW FPGA Module

The LabVIEW FPGA Module extends the LabVIEW graphical development platform to target field-programmable gate arrays (FPGAs) on NI reconfigurable I/O (RIO) hardware. LabVIEW FPGA enables developers to more efficiently and effectively design complex systems by providing a highly integrated development environment, a large ecosystem of IP libraries, a high fidelity simulator, and debugging features.

NI Vision Development Module

The NI Vision Development Module is an image processing and analysis library with hundreds of functions for the following common machine vision tasks:

- Pattern matching
- Particle analysis
- Gauging
- Taking measurements
- Grayscale, color, and binary image display

Using the NI Vision Development Module, imaging novices and experts can program the most basic or complicated image applications without knowledge of particular algorithm implementations.

NI Vision Assistant, which is included with the NI Vision Development Module, is an interactive prototyping tool for machine vision and scientific imaging developers. With Vision Assistant, you can prototype vision applications quickly and test how various vision image processing functions work. Using the Vision Assistant LabVIEW VI creation wizard, you can create LabVIEW VI block diagrams that perform the prototype you created in Vision Assistant. You can use them in LabVIEW to add functionality to the generated VI.

For information about how to use the NI Vision Development Module with LabVIEW, refer to the *NI Vision for LabVIEW Help*.

NI Vision Acquisition Software

The NI CVS-1459RT ships with the latest version of NI Vision Acquisition Software, which contains all of the drivers in the NI Vision product line. With NI Vision Acquisition Software, you can quickly and easily start your applications without having to program the device at the register level.

NI Vision Acquisition Software has an extensive library of functions—such as routines for video configuration, continuous and single shot image acquisition, memory buffer allocation, trigger control, and device configuration—that you can call from the application development environment.

NI Vision Acquisition Software contains the following software for use with the NI CVS-1459RT:

- **NI-IMAQdx**—Controls USB3 Vision cameras connected to the NI CVS-1459RT. NI-IMAQdx includes an extensive library of VIs you can call from LabVIEW. These VIs include routines for video configuration, continuous and single-shot image acquisition, trigger control, and register-level camera configuration. NI-IMAQdx software performs all functions necessary for acquiring and saving images.
- **NI-IMAQ I/O**—Controls the reconfigurable digital I/O on the NI CVS-1459RT.
- **NI Measurement & Automation Explorer (NI MAX)**—Use MAX to configure the NI CVS-1459RT.

2

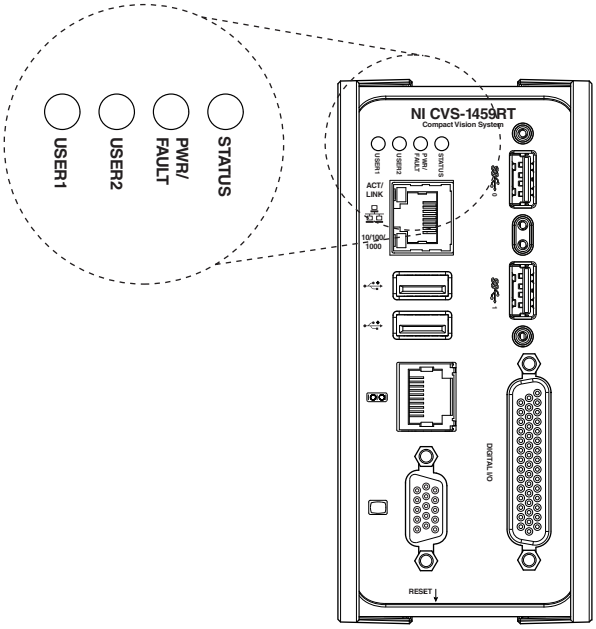
LED Indicators and the RESET Button

This chapter provides information about the location and functionality of the LED indicators and the RESET button on the NI CVS-1459RT.

LED Indicators

Figure 2-1 shows the LEDs on the NI CVS-1459RT.

Figure 2-1. LED Indicators



STATUS LED

The following table describes the STATUS LED indications.

Table 2-1. STATUS LED Indications

STATUS LED (Amber) State	NI CVS-1459RT State
OFF	The NI CVS-1459RT initialized successfully and is ready for use.
2 blinks	There is no software installed, which is the out-of-box state, or the NI CVS-1459RT has detected an error in its software. The device has automatically started up into safe mode. This usually occurs when an attempt to upgrade the software is interrupted or if system files are deleted from the NI CVS-1459RT. Reinstall software on the NI CVS-1459RT. Refer to the *NI CVS-1459RT Getting Started Guide* for information about installing software.
3 blinks	The NI CVS-1459RT has booted into safe mode. Refer to the *Safe Mode* section for information about the safe mode state.
4 blinks	The NI CVS-1459RT has experienced two consecutive software exceptions. The NI CVS-1459RT automatically restarts after an exception. After the second exception, the NI CVS-1459RT remains in the exception state, alerting you to resolve the problem. Reinstall software on the NI CVS-1459RT or contact National Instruments for assistance. Refer to the *NI CVS-1459RT Getting Started Guide* for information about installing software on the NI CVS-1459RT.
Continuous blink	The NI CVS-1459RT has not booted into NI Linux Real-Time. The controller either booted into an unsupported operating system, was interrupted during the boot process, or detected an unrecoverable software error.
ON	The NI CVS-1459RT is booting up.

PWR/FAULT LED

The following table describes the PWR/FAULT LED indications.

Table 2-2. PWR/FAULT LED Indications

PWR/FAULT LED (Green/Red) State	NI CVS-1459RT State
OFF	The NI CVS-1459RT is OFF. This is not an indication of whether power is applied or not.
ON - Green	The NI CVS-1459RT is operating normally and is properly powered on.
Blinking - Red	The NI CVS-1459RT power-up sequence failed.

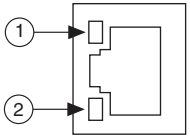
USER1/USER2 LEDs

The USER1 and USER2 LEDs are user-accessible LEDs that can be controlled with the RT LEDs VI, which is located on the RT Utilities palette in LabVIEW. Both LEDs are bicolor Green/Amber LEDs.

Ethernet LEDs

Figure 2-2 shows the LEDs for the primary Gigabit Ethernet network port. The primary network port provides a connection between the NI CVS-1459RT and the development computer.

Figure 2-2. LEDs for the Primary Gigabit Ethernet Network Port



1 Activity/Link LED 2 Speed LED

Refer to Table 2-3 for information on the Ethernet LED indications.

Table 2-3. Ethernet LED Indications

LED	Status	Definition
Activity/Link	Unlit	No link has been established
	Solid	A link has been negotiated
	Blinking	Activity on the link

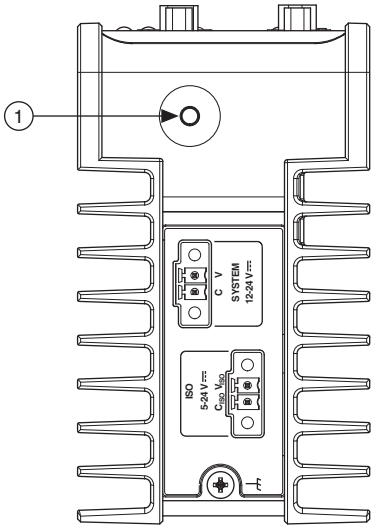
Table 2-3. Ethernet LED Indications (Continued)

LED	Status	Definition
Speed	Unlit	No link, or 10 Mbps link
	Green	100 Mbps link
	Amber	1,000 Mbps link

Using the RESET Button

Figure 2-3 shows the location of the RESET button on the NI CVS-1459RT.

Figure 2-3. RESET Button Location



1 RESET Button

Pressing the RESET button resets the processor in the same manner as cycling power.

You can also use the RESET button to troubleshoot network connectivity:

1. Hold the RESET button for 5 seconds, and then release it to boot the NI CVS-1459RT into safe mode.
2. After booting the controller into safe mode, hold the RESET button again for 5 seconds to enable IP reset, which resets the network adapter to its default configuration.

The following sections describe safe mode and IP reset.

Safe Mode

When you boot the NI CVS-1459RT into safe mode, it launches only the services necessary for updating its configuration and installing software. To resume normal operations, press the RESET button for less than 5 seconds.

IP Reset

Use IP reset to reset the TCP/IP settings when moving the system from one subnet to another or when the current TCP/IP settings are invalid.

When the NI CVS-1459RT is in the IP reset state**,** the IP address of the network port resets to DHCP or a link-local address. You can then set up a new network configuration for the NI CVS-1459RT from a development machine on the same subnet, or you can connect the NI CVS-1459RT directly to the development computer.

Note By default, the target automatically attempts to connect to the network using DHCP. If the target is unable to initiate a DHCP connection, the target connects to the network with a link-local IP address (`169.254.x.x`).

3

Connector Pinouts

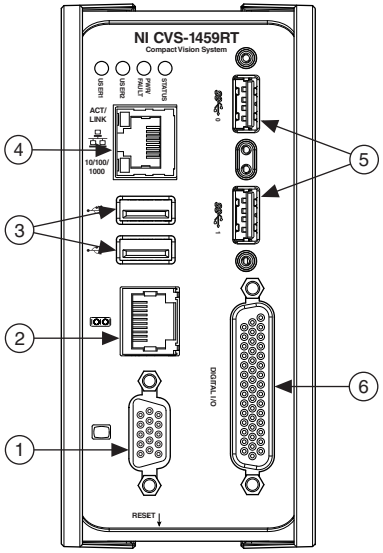
This chapter describes the connectors on the NI CVS-1459RT and includes pinouts and signal descriptions for each connector. Table 3-1 summarizes the functions of the connectors and features on the NI CVS-1459RT.

Table 3-1. Connector Overview

Connector	Function
Chassis Grounding Screw	Connects chassis to earth ground
2-position SYSTEM power connector	System power
2-position ISO power connector	Power to isolated outputs
RJ45 10/100/1000 Ethernet port	Network connection
USB 2.0 Standard A receptacles	High-retention USB 2.0
RJ50 serial port	RS-485/422/232 serial
15-pin female VGA port	Video output
USB 3.0 Standard A receptacles	Power and data connection to USB3 Vision cameras
44-pin female HD D-sub DIGITAL I/O port	Isolated inputs, isolated outputs, bidirectional differential lines (RS-422) or single-ended lines which can be used with a quadrature encoder, and bidirectional TTL lines

Figure 3-1 shows the locations of the connectors.

Figure 3-1. NI CVS-1459RT Front Panel Connectors



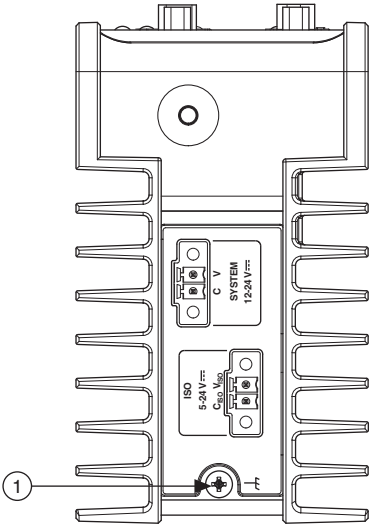
1	VGA Connector	4	RJ45 Gigabit Ethernet Network Port
2	RJ50 Serial Port	5	USB3 Vision Ports
3	USB 2.0 Ports	6	44-pin Digital I/O Connector

Chassis Grounding Screw

Use the grounding screw on the NI CVS-1459RT, shown in Figure 3-2, to connect the chassis to earth ground. An earth ground connection is optional.

Note An earth ground connection does not connect C or C_{ISO} to earth ground.

Figure 3-2. External Ground Location

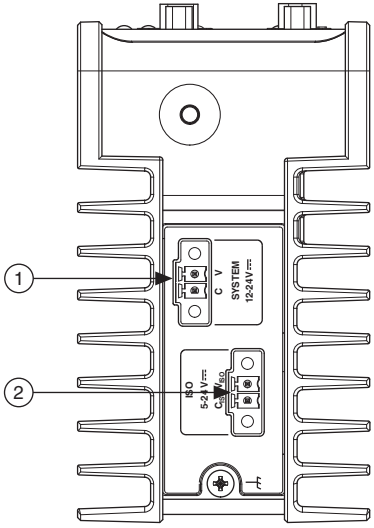


1 Chassis Grounding Screw

Power Input Connectors

The NI CVS-1459RT uses two power supplies to power the system and to power the isolated outputs. Figure 3-3 shows the power connectors.

Figure 3-3. Power Connectors



1 System Power Connector 2 Isolated Outputs Power Connector

Table 3-2 describes the terminals on the power connectors.

Table 3-2. Power Connector Terminals

Terminal	Description
C	Common signal
V	System power (12-24 VDC)
C_{ISO}	Isolated common signal
V_{ISO}	Power for isolated outputs (5-24 VDC)

Ethernet Port

The Ethernet port on the NI CVS-1459RT provides a connection between the NI CVS-1459RT and the development computer, either directly or through a network. The NI CVS-1459RT automatically detects the speed of the connection and configures itself accordingly.

A CAT 5e or CAT 6 1000Base-T Ethernet cable is required to achieve maximum 1,000 Mbps (Gigabit) Ethernet performance. CAT 5e and CAT 6 Ethernet cables adhere to higher electrical standards required for Gigabit Ethernet communication. CAT 5 cables are not guaranteed to meet the necessary requirements. While CAT 5 cables may appear to work at 1,000 Mbps, CAT 5 cables can cause bit errors, resulting in degraded or unreliable network performance.

Figure 3-4 shows the pin locations for the Ethernet port.

Figure 3-4. Primary Ethernet Port Pin Locations

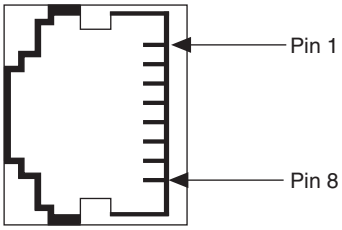


Table 3-3 lists the pin descriptions.

Table 3-3. Ethernet Port Pin Descriptions

Pin	Fast Ethernet	Gigabit Ethernet	
		MDI	MDI-X
1	TX+	BI_DA+	BI_DB+
2	TX–	BI_DA–	BI_DB–
3	RX+	BI_DB+	BI_DA+
4	No Connect	BI_DC+	BI_DD+
5	No Connect	BI_DC–	BI_DD–
6	RX–	BI_DB–	BI_DA–
7	No Connect	BI_DD+	BI_DC+
8	No Connect	BI_DD–	BI_DC–

USB 2.0 Ports

The NI CVS-1459RT has two high-retention USB 2.0 ports. The USB ports support common USB mass-storage devices such as USB flash drives, USB-to-IDE adapters, keyboards, and mice.

LabVIEW usually maps USB mass-storage devices to the /U, /V, /W, or /X drive, starting with the /U drive if it is available. Refer to the *LabVIEW Help* for more information.

Figure 3-5 shows the pinout for the USB connectors.

Figure 3-5. USB 2.0 Connector Pinout

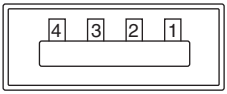


Table 3-4 lists and describes the USB connector signals.

Table 3-4. USB Connector Signals

Pin	Signal Name	Signal Description
1	VCC	Cable Power (+5 VDC)
2	D-	USB Data -
3	D+	USB Data +
4	GND	Ground

RS-485/422/232 Serial Port

The NI CVS-1459RT has a single serial port that can operate in either RS-485/422 mode or RS-232 mode. Set the serial port mode in the BIOS. Refer to the *Serial Port Configuration Submenu* section of Chapter 5, *BIOS Configuration and System Recovery*, for more information.

The serial port is a 10-position RJ50 modular jack, which you can connect to serial devices, such as PLCs, scanners, and lighting devices. Refer to Figure 3-6 for the pin locations.

Figure 3-6. RS-485/422/232 Serial Port Pin Locations

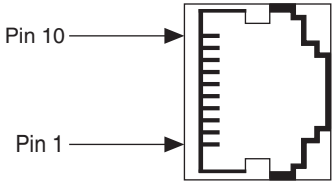


Table 3-5 lists the signal descriptions for the serial port.

Table 3-5. Serial Port Pin Descriptions

Pin	RS-485/422 Mode	RS-232 Mode
1	No Connect	No Connect
2	TXD–	Unused
3	TXD+	Unused
4	No Connect	No Connect
5	No Connect	No Connect
6	RXD–	GND
7	RXD+	Unused
8	Unused	TXD
9	Unused	RXD
10	GND	GND

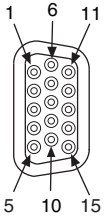
VGA Port

Use the VGA port to connect a monitor to the NI CVS-1459RT. Use any standard 15-pin VGA cable to access the VGA port. The VGA port has a maximum resolution of 1920 x 1200 at 60 Hz.

You can develop a single real-time VI to use for both your user interface and system logic. For more information, refer to the *Using the Embedded UI to Access RT Target VIs* topic in the *LabVIEW Help*.

Figure 3-7 shows the VGA port pin locations.

Figure 3-7. VGA Port Pin Locations



The following table lists the VGA signals.

Table 3-6. VGA Port Pin Descriptions

Pin	Signal Name	Signal Description
1	RED	Red analog video signal
2	GREEN	Green analog video signal
3	BLUE	Blue analog video signal
4	RESERVED	Reserved
5	GND	Ground reference
6	RED RETURN	Ground reference
7	GREEN RETURN	Ground reference
8	BLUE RETURN	Ground reference
9	PWR	5 V power for DDC
10	GND	Ground return for power
11	NC	No Connect
12	DDC_D	Data signal of serial communication
13	HSYNC	Horizontal synchronization signal
14	VSYNC	Vertical synchronization signal
15	DDC_C	Clock signal of serial communication

USB3 Vision Ports

The NI CVS-1459RT provides two standard A USB 3.0 ports to acquire images from two USB3 Vision cameras simultaneously. The USB ports also support common USB mass-storage devices such as USB flash drives, USB-to-IDE adapters, keyboards, and mice.

LabVIEW usually maps USB mass-storage devices to the /U, /V, /W, or /X drive, starting with the /U drive if it is available. Refer to the *LabVIEW Help* for more information.

Figure 3-8 shows the pinout for the USB 3.0 connectors.

Figure 3-8. USB3 Vision Port Pin Locations

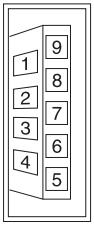


Table 3-4 lists and describes the USB 3.0 connector signals.

Table 3-7. USB3 Vision Connector Signals

Pin	Signal Name	Signal Description
1	VBUS	Power
2	D-	USB 2.0 differential pair
3	D+	
4	GND	Ground for power return
5	StdA_SSRX-	SuperSpeed receiver differential pair
6	StdA_SSRX+	
7	GND_DRAIN	Ground for signal return
8	StdA_SSTX-	SuperSpeed transmitter differential pair
9	StdA_SSTX+	

Digital I/O

The 44-pin Digital I/O port on the NI CVS-1459RT offers 8 isolated inputs, 8 isolated outputs, 2 bidirectional differential inputs (RS-422) or single-ended input lines that can be used with a quadrature encoder, and 8 bidirectional TTL lines. The Digital I/O port can be connected to any appropriate shielded device or connector block using a shielded cable. Refer to Table 3-8 for pin locations and functions.

Table 3-8. Pin Location and Definition for the NI CVS-1459RT Digital I/O

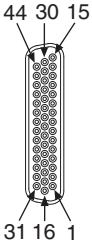
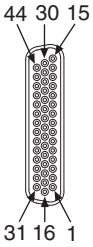
Pin Location	Pin Number	Signal	Description
	1	Diff 0+	Bidirectional RS-422 I/O (positive side), or quadrature encoder phase A+
	2	GND	Digital ground reference for TTL and differential I/O
	3	TTL 0	Bidirectional TTL I/O
	4	TTL 1	Bidirectional TTL I/O
	5	GND	Digital ground reference for TTL and differential I/O
	6	TTL 2	Bidirectional TTL I/O
	7	TTL 3	Bidirectional TTL I/O
	8	GND	Digital ground reference for TTL and differential I/O
	9	Diff 1+	Bidirectional RS-422 I/O (positive side), or quadrature encoder phase B+
	10	V_{ISO}	Isolated power voltage reference output
	11	C_{ISO}	Common ground reference for isolated inputs and outputs
	12	Iso Out 0	General purpose isolated output
	13	Iso Out 1	General purpose isolated output
	14	C_{ISO}	Common ground reference for isolated inputs and outputs
	15	Iso Out 4	General purpose isolated output
	16	Diff 0-	Bidirectional RS-422 I/O (negative side), or quadrature encoder phase A-
	17	GND	Digital ground reference for TTL and differential I/O
	18	TTL 4	Bidirectional TTL I/O
	19	TTL 5	Bidirectional TTL I/O
	20	GND	Digital ground reference for TTL and differential I/O

Table 3-8. Pin Location and Definition for the NI CVS-1459RT Digital I/O (Continued)

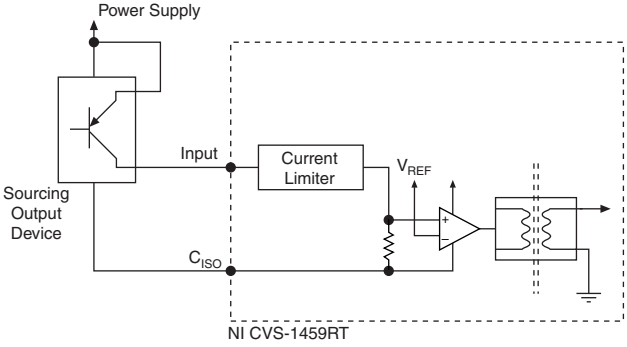
Pin Location	Pin Number	Signal	Description
	21	TTL 6	Bidirectional TTL I/O
	22	TTL 7	Bidirectional TTL I/O
	23	GND	Digital ground reference for TTL and differential I/O
	24	Diff 1-	Bidirectional RS-422 I/O (negative side), or quadrature encoder phase B-
	25	V_{ISO}	Isolated power voltage reference output
	26	C_{ISO}	Common ground reference for isolated inputs and outputs
	27	Iso Out 2	General purpose isolated output
	28	Iso Out 3	General purpose isolated output
	29	C_{ISO}	Common ground reference for isolated inputs and outputs
	30	Iso Out 5	General purpose isolated output
	31	Iso In 0	General purpose isolated input
	32	Iso In 1	General purpose isolated input
	33	C_{ISO}	Common ground reference for isolated inputs and outputs
	34	Iso In 2	General purpose isolated input
	35	Iso In 3	General purpose isolated input
	36	C_{ISO}	Common ground reference for isolated inputs and outputs
	37	Iso In 4	General purpose isolated input
	38	Iso In 5	General purpose isolated input
	39	C_{ISO}	Common ground reference for isolated inputs and outputs
	40	Iso In 6	General purpose isolated input
	41	Iso In 7	General purpose isolated input
	42	C_{ISO}	Common ground reference for isolated inputs and outputs
	43	Iso Out 6	General purpose isolated output
	44	Iso Out 7	General purpose isolated output

Wiring an Isolated Input

You can wire an isolated input to a sourcing output device, as shown in the Figure 3-9.

Caution Do *not* apply a voltage greater than 24 VDC to the isolated inputs. Voltage greater than 24 VDC may damage the NI CVS-1459RT.

Figure 3-9. Connecting an Isolated Input to a Sourcing Output Device

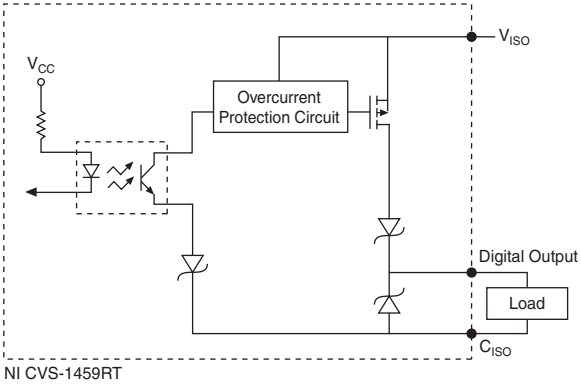


Wiring an Isolated Output

The digital output circuit sources current to external loads, as shown in Figure 3-10.

Caution Do *not* draw more than 35 mA each from 5 V isolated outputs. Do *not* draw more than 80 mA each from 24 V isolated outputs.

Figure 3-10. Connecting an Isolated Output to an External Load



Connecting to Differential I/O

The NI CVS-1459RT accepts differential (RS-422) line driver inputs. Each of the 2 differential I/O can be configured as an output. Use shielded cables for all applications. Unshielded cables are more susceptible to noise and can corrupt signals. Figure 3-11 shows the differential input/quadrature encoder input circuit. Figure 3-12 and Figure 3-13 show differential and single-ended line driver connections.

Figure 3-11. Quadrature Encoder/RS-422 Input/Output Circuit

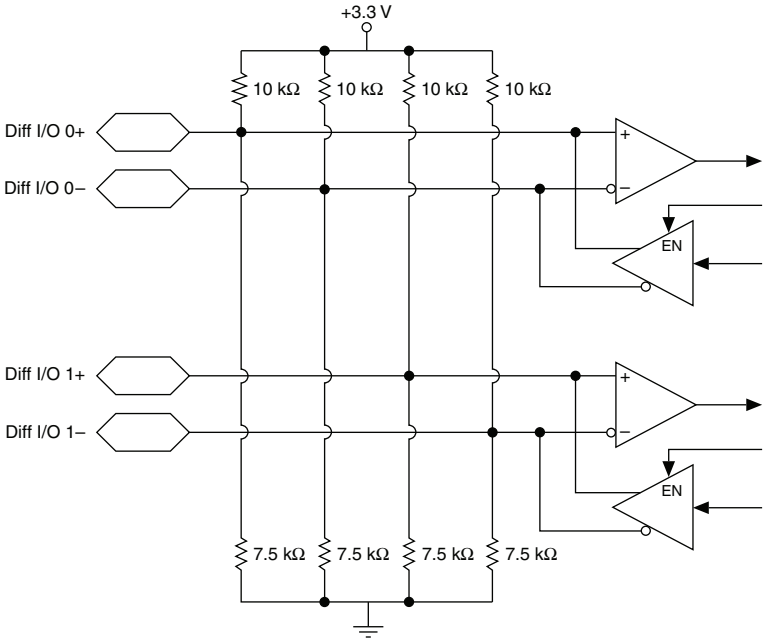


Figure 3-12. Connecting Differential Line Drivers

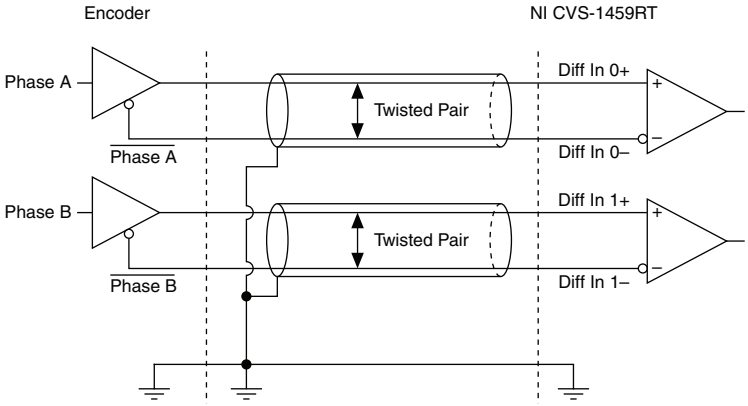
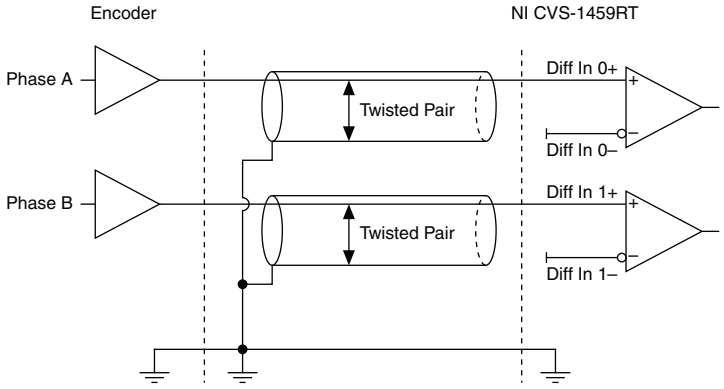


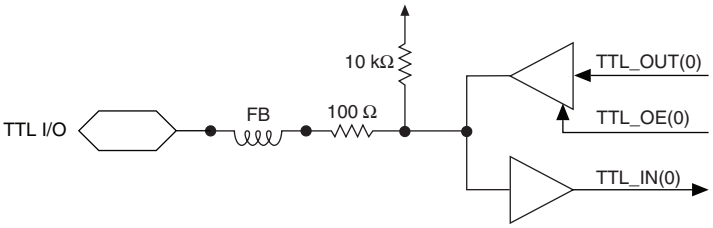
Figure 3-13. Connecting Single-Ended Line Drivers



TTL I/O

Figure 3-14 shows the circuit for a bidirectional TTL I/O.

Figure 3-14. TTL Input/Output Circuit



4

Deployment

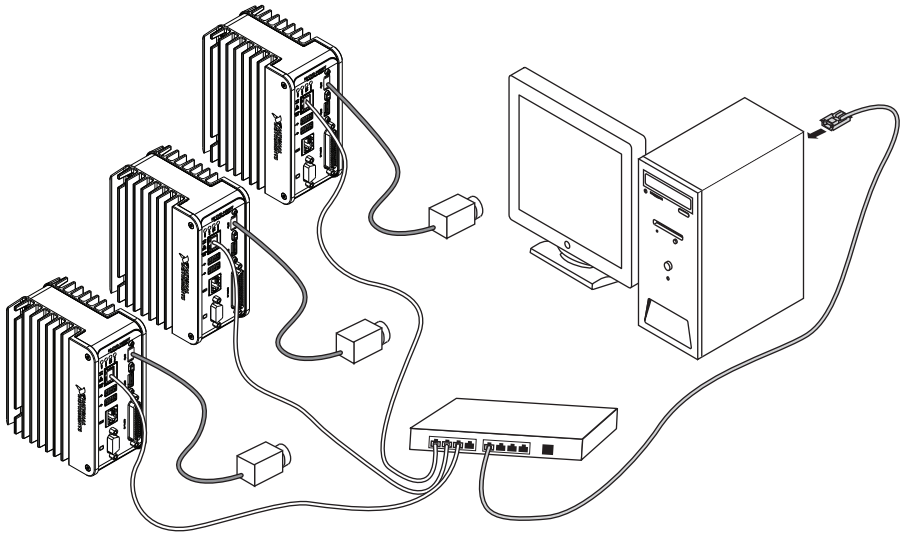
This chapter provides guidelines for connecting the NI CVS-1459RT to a network.

Connecting Multiple NI CVS-1459RT Devices

An Ethernet connection between the development computer and the NI CVS-1459RT allows you to assign an IP address, configure the NI CVS-1459RT, download inspection tasks, and remotely monitor an ongoing inspection.

You can connect multiple NI CVS-1459RT devices to the same network, as shown in Figure 4-1.

Figure 4-1. Multiple NI CVS-1459RT Devices Connected to the Same Network



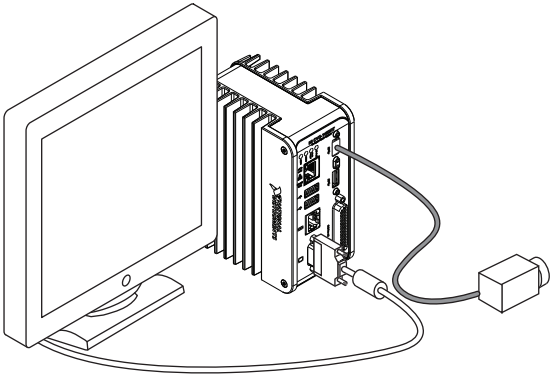
To connect multiple NI CVS-1459RT devices to the same network, each device must have a unique IP address. By default, the configuration utility running on the development computer displays each NI CVS-1459RT that exists on the subnet. To add entries for NI CVS-1459RT devices that exist on other subnets, you must know the IP address assigned to each device. This feature allows remote configuration, programming, and monitoring of any NI CVS-1459RT not protected by a firewall or user password.

Use the NI CVS-1459RT serial number to uniquely identify each unit. The serial number is printed on the top side of each NI CVS-1459RT.

The configuration environment on the host machine displays these values in order to distinguish one NI CVS-1459RT from another. In addition to distinguishing units based on serial number, you can also assign each NI CVS-1459RT a descriptive name in the configuration environment. The default name for each device is **NI-CVS1459RT-XXXXXXXX**, where **XXXXXXXX** is the eight digit serial number.

When configured to run an inspection, the NI CVS-1459RT can run autonomously without connection to the host machine. All image acquisition, inspection, decision making, and I/O occurs on the NI CVS-1459RT device itself. For local monitoring of the inspection, you can connect a monitor directly to the VGA connector on the NI CVS-1459RT, as shown in Figure 4-2.

Figure 4-2. NI CVS-1459RT Connected to a Monitor



At any time, you can reconnect the host machine to the NI CVS-1459RT device and remotely monitor progress.

5

BIOS Configuration and System Recovery

You can change the configuration settings for the NI CVS-1459RT in the BIOS setup. The BIOS is the low-level interface between the hardware and PC software that configures and tests your hardware when you boot the system. The BIOS setup program includes menus for configuring settings and enabling features.

Most users do not need to use the BIOS setup program. The system ships with default settings that work well for most configurations.

Entering BIOS Setup

To start the BIOS setup program, complete the following steps:

1. Connect a VGA monitor to the VGA connector of the NI CVS-1459RT.
2. Connect a USB keyboard to one of the USB ports on the NI CVS-1459RT.
3. While holding down the <Delete> key, power on or reboot the NI CVS-1459RT.

The NI CVS-1459RT will enter the BIOS setup program and display the **Main** menu.

Use the following keys to navigate through the BIOS setup:

- **Left, right, up, and down arrows**—Use these keys to move between different setup menus. Press <Esc> to exit a submenu. Be sure number lock is off to use the numeric keypad arrows.
- **<Enter>**—Use this key either to open a submenu or display all available settings for the highlighted configuration option.
- **<Esc>**—Use this key to return to a parent menu of a submenu or cancel an outstanding selection. At the main menu, use this key to exit the BIOS setup.
- **<+> and <–>**—Use these keys to cycle between all available settings.
- **<Tab>**—Use this key to select time and date fields. When entering time and date information, you can also use the number keys to enter the time and date directly.
- <**F9**>—Use this key to load the optimal default values for BIOS configuration settings. The optimal default values are the same as the shipping configuration default values.

Press <F1> from any root menu to display more information about navigating the BIOS setup program.

Menu items listed in blue are changeable; menu items in gray are not changeable. A blue triangle next to a menu item indicates that the menu item contains a submenu.

The following sections describe the entries available in each BIOS menu.

Main Menu

The most commonly accessed and modified BIOS settings are in the **Main** setup menu. The **Main** setup menu includes the following settings:

- **System Date**—Changes the system date. The system date setting is stored in a battery-backed real-time clock. You can also change this setting from within MAX or Vision Builder AI.
- **System Time**—Changes the system time. The system time setting is stored in a battery-backed real-time clock. You can also change this setting from within MAX or Vision Builder AI.

Advanced Menu

This menu contains BIOS settings that normally do not require modification. If you have specific problems such as unbootable disks or resource conflicts, you may need to examine these settings.

The **Advanced** setup menu includes the following settings:

- **Power/Wake Configuration**—Use this setting to bring up the **Power/Wake Configuration** submenu. For information about the menu items within this submenu, refer to the *Power/Wake Configuration Submenu* section.
- **Serial Port Configuration**—Use this setting to bring up the **Serial Port Configuration** submenu. For information about the menu items within this submenu, refer to the *Serial Port Configuration Submenu* section.
- **SATA Configuration**—Use this setting to bring up the **SATA Configuration** submenu. For information about the menu items within this submenu, refer to the *SATA Configuration Submenu* section.
- **USB Configuration**—Use this setting to bring up the **USB Configuration** submenu. For information about the menu items within this submenu, refer to the *USB Configuration Submenu* section.

Power/Wake Configuration Submenu

Use this submenu to apply alternate configurations to the power features of the chipset and controller. Normally, you do not need to modify these settings, as the factory default settings provide the most compatible and optimal configuration possible.

- **Restore After Power Loss**—Specify what state to go to when power is reapplied after a power failure.

Serial Port Configuration Submenu

Use this submenu to view the serial port configuration.

- **RS485/RS232 Select**—This setting selects the transceiver mode between RS-232 and RS-485. The default value is **RS485**.
- **RS-485 Configuration**—Use this menu to configure the RS-485/422 wire-mode. The default value is **Auto**.

SATA Configuration Submenu

Use this submenu to apply custom configurations to the processor of the NI CVS-1459RT. Normally, you do not need to modify these settings, as the factory default settings provide the most compatible and optimal configuration possible.

- **SATA Controller(s)**—Enables or disables the SATA controller. The default is **Enabled.**

USB Configuration Submenu

Use this submenu to apply alternate configurations to the USB ports. Normally, you do not need to modify these settings, as the factory default settings provide the most compatible and optimal configuration possible.

- **Legacy USB Support**—Specifies whether or not legacy USB support is enabled. Legacy USB support refers to the ability to use a USB keyboard and mouse during system boot or in a legacy operating system such as DOS. The default is **Enabled**.
- **Overcurrent Reporting**—Enables or disables operating system notifications of USB overcurrent events. The default is **Disabled**.
- **Transfer Timeout**—Specifies the number of seconds the POST waits for a USB mass storage device to complete a transaction. The default is **20** seconds.
- **Device Reset Timeout**—Specifies the number of seconds the POST waits for a USB mass storage device to start. The default is **20** seconds.
- **Device Power-Up Delay**—Specifies the maximum amount of time a device can take to properly report itself during the POST. The default value is **Auto**. Alternatively, a **Manual** override setting can be used to support very slow USB devices.
- **Mass Storage Devices**—When USB storage is connected to the device, this menu lists each USB drive. You can set the emulation type of the USB storage. The options include Auto, Floppy, Forced FDD, Hard Disk, and CD-ROM. The default is **Auto**.

Boot Menu

This screen displays the boot order of devices associated with the NI CVS-1459RT. The BIOS proceeds down the **Boot priority order list** in search of a bootable device. Devices under the **Excluded from boot order** list will not be used for booting. If the BIOS fails to find any bootable device, an error message is displayed, and the system halts, or the BIOS setup screen appears.

- **Boot Settings Configuration**—Use this setting to access the **Boot Settings Configuration** submenu. Refer to the *Boot Settings Configuration Submenu* section for more information.

- **PXE Network Boot**—This setting specifies whether or not the PXE network boot agent is enabled. When this setting is enabled, the Intel Boot Agent is displayed in the **Boot Option Priorities** menu, allowing you to boot from a PXE server on the local subnet. Note that the Intel Boot Agent device names are preceded by **IBA GE Slot** in the **Boot Option Priorities** menu. The system must be restarted for this setting to take effect. The default value is **Disabled**.
- **Boot Option Priorities**—These settings specify the order in which the BIOS checks for bootable devices, including the local hard disk drive, removable devices such as USB flash disk drives or USB CD-ROM drives, or the PXE network boot agent. The BIOS will first attempt to boot from the device associated with **Boot Option #1**, followed by **Boot Option #2**, and **Boot Option #3**. If multiple boot devices are not present, the BIOS setup utility will not display all of these configuration options. To select a boot device, press <Enter> on the desired configuration option and select a boot device from the resulting menu. You can also disable certain boot devices by selecting **Disabled**.

Note Only one device of a given type will be shown in this list. If more than one device of the same type exists, use the *Device BBS Priorities* submenus to re-order the priority of devices of the same type.

Boot Settings Configuration Submenu

- **Setup Prompt Timeout**—This setting specifies the amount of time the system waits for a BIOS Setup menu keypress (the <Delete> key) in units of a second. The default value is **1** for a delay of 1 seconds.
- **Bootup NumLock State**—This setting specifies the power-on state of the keyboard NumLock setting. The default value is **On**.

Device BBS Priority Submenus

The following submenus will be displayed if one or more bootable devices of the corresponding type is present:

- **Hard Drive BBS Priorities**—Use this setting to access the **Hard Drive BBS Priorities** submenu to re-order or disable bootable hard drive devices. Refer to the *Hard Drive BBS Priorities Submenu* section for more information.
- **CD/DVD ROM Drive BBS Priorities**—Use this setting to access the **CD/DVD ROM Drive BBS Priorities** submenu to re-order or disable bootable CD/DVD ROM drive devices. Refer to the *CD/DVD ROM Drive BBS Priorities Submenu* section for more information.
- **Floppy Drive BBS Priorities**—Use this setting to access the **Floppy Drive BBS Priorities** submenu to re-order or disable bootable floppy drive devices. Refer to the *Floppy Drive BBS Priorities Submenu* section for more information.
- **Network Device BBS Priorities**—Use this setting to access the **Network Device BBS Priorities** submenu to re-order or disable bootable network devices. Refer to the *Network Device BBS Priorities Submenu* section for more information.

Hard Drive BBS Priorities Submenu

- **Boot Option #1, Boot Option #2, Boot Option #3**—These settings specify the boot priority of hard drive devices. The highest priority device is displayed on the main **Boot Option Priorities** list. Optionally, each device can also be **Disabled** if the device should never be used as a boot device.

CD/DVD ROM Drive BBS Priorities Submenu

- **Boot Option #1, Boot Option #2, Boot Option #3**—These settings specify the boot priority of CD/DVD ROM drive devices. The highest priority device is displayed on the main **Boot Option Priorities** list. Optionally, each device can also be **Disabled** if the device should never be used as a boot device.

Floppy Drive BBS Priorities Submenu

- **Boot Option #1, Boot Option #2, Boot Option #3**—These settings specify the boot priority of floppy drive devices. The highest priority device is displayed on the main **Boot Option Priorities** list. Optionally, each device can also be **Disabled** if the device should never be used as a boot device.

Network Device BBS Priorities Submenu

- **Boot Option #1, Boot Option #2, Boot Option #3**—These settings specify the boot priority of network devices. The highest priority device is displayed on the main **Boot Option Priorities** list. Optionally, each device can also be **Disabled** if the device should never be used as a boot device.

Save & Exit Menu

The **Save & Exit** setup menu includes all available options for exiting, saving, and loading the BIOS default configuration. You can also press <F9> to load BIOS default settings and <F10> to save changes and exit setup.

The **Save & Exit** setup menu includes the following settings:

- **Save Changes and Reset**—Any changes made to BIOS settings are stored in NVRAM. The setup utility then exits and reboots the controller.
- **Discard Changes and Reset**—Any changes made to BIOS settings during this session of the BIOS setup utility since the last save are discarded. The setup utility then exits and reboots the controller. The <Esc> key can also be used to select this option.
- **Save Changes**—Changes made to BIOS settings during this session are committed to NVRAM. The setup utility remains active, allowing further changes.
- **Discard Changes**—Any changes made to BIOS settings during this session of the BIOS setup utility since the last save are discarded. The BIOS setup continues to be active.
- **Restore Factory Defaults**—This option restores all BIOS settings to the factory default. This option is useful if the controller exhibits unpredictable behavior due to an incorrect or

inappropriate BIOS setting. Any nondefault settings are also restored to their factory defaults. The <F9> key can also be used to select this option.

- **Save as User Defaults**—This option saves a copy of the current BIOS settings as the User Defaults. This option is useful for preserving custom BIOS setup configurations.
- **Restore User Defaults**—This option restores all BIOS settings to the user defaults. This option is useful for restoring previously preserved custom BIOS setup configurations.
- **Boot Override**—This option lists all possible bootable devices and allows the user to override the **Boot Option Priorities** list for the current boot. If no changes have been made to the BIOS setup options, the system will continue booting to the selected device without first rebooting. If BIOS setup options have been changed and saved, a reboot is required and the boot override selection will not be valid.

Restoring the NI CVS-1459RT to Factory Default Condition

Complete the following steps to restore the NI CVS-1459RT to its factory default condition. These steps do not restore the BIOS settings to factory default. Use the **Restore Factory Defaults** option in the *Save & Exit Menu* of the BIOS to restore the BIOS settings.

1. Start the NI CVS-1459RT in safe mode. To start in safe mode, press the RESET button for more than 5 seconds.
2. Launch MAX.
3. In the MAX configuration tree, expand **Remote Systems**.
4. Right-click the name of the NI CVS-1459RT you want to restore and select **Format Disk**.
5. After the format completes, disable safe mode by pressing the RESET button for less than 5 seconds.
6. Refer to the *NI CVS-1459RT Getting Started Guide* for information about installing software and configuring the NI CVS-1459RT.

A

Troubleshooting

This appendix provides instructions for troubleshooting the NI CVS-1459RT.

Software Configuration Problems

The NI CVS-1459RT Does Not Appear in MAX or in Vision Builder AI

Possible causes and solutions:

- The NI CVS-1459RT may not be powered. Verify that there is system power to the device and that both the NI CVS-1459RT and the development computer are properly connected to the network. The PWR/FAULT LED should be lit green and the ACTIVITY/LINK LED on the primary network port should flash green when refreshing the list of devices in MAX or Vision Builder AI.
- The NI CVS-1459RT may have been configured on another network and then moved to the current network. Reconfigure the NI CVS-1459RT device for the current network.

Note Connect a monitor and keyboard to the NI CVS-1459RT and press <Enter> to view the current configuration settings of the device.

- Another device on the network is using the IP address assigned to the NI CVS-1459RT. This can happen when you assign the same static IP to two devices, you assign a static IP that is in the range of the IP address available for DHCP use on your network, or the DHCP server assigns the same IP address to another device. Either remove or reconfigure the other device, or reconfigure the NI CVS-1459RT to use a different IP address by putting it into the IP RESET state and restarting into the normal state.
- The cable you are using may be inappropriate for the speed of your network, causing network communication dropout. While 1,000 Mbps communication over short cables lengths can be achieved with the CAT5 cable commonly used for 10 and 100 Mbps, CAT5e and CAT6 cables are more reliable and recommended for 1,000 Mbps links. The NI CVS-1459RT has the ability to perform auto-crossover, allowing the use of straight or crossover Ethernet cables, independent of the connection configuration.
- The NI CVS-1459RT is configured to acquire an IP address from a DHCP server, but no DHCP server is available. By default, the target will automatically attempt to connect to the network using DHCP. If the target is unable to initiate a DHCP connection, the target connects to the network with a link-local IP address (`169.254.x.x`).

- You may be experiencing firewall issues. If you are having difficulty detecting the system and setting up the NI CVS-1459RT on your network, you must configure the firewall to open the TCP/UDP ports used by the NI CVS-1459RT and the host machine. Refer to the following table for more information about TCP/UDP ports.

Table A-1. TCP/UDP Ports Used by the NI CVS-1459RT

Port	Type	Details
3580	TCP/UDP	Reserved as nati-svrloc (NAT-ServiceLocator). Used by Measurement & Automation Explorer (MAX) to locate remote targets.
7749	TCP	Used for remote image display (not reserved).
7750	TCP	Used for NI-IMAQdx remote configuration (not reserved).
3363	TCP/UDP	Reserved as nati-vi-server (NATI VI Server). Used by Vision Builder for Automated Inspection to configure a remote target.

  If your firewall is controlled remotely or you are unsure about configuring the firewall, contact your network administrator.

No Software is Installed

If MAX or Vision Builder AI report that no software is installed, install application and driver software on the NI CVS-1459RT. Refer to the *NI CVS-1459RT Getting Started Guide* for installation instructions.

No Camera Found

Verify that the camera is properly connected and powered. Verify that the camera complies with the USB3 Vision specification.

Hardware Problems

Cannot Drive Isolated Outputs

Verify that you have power connected to the V_{ISO} and C_{ISO} inputs on the NI CVS-1459RT isolated power connector and that the contact at the screw terminals is solid. Because these outputs are electrically isolated from the NI CVS-1459RT device main supply, they require power in addition to the NI CVS-1459RT main supply.

Runaway Startup Application

If a runaway startup application causes the NI CVS-1459RT to become unresponsive, power off the NI CVS-1459RT and then restart it in safe mode. Restarting the NI CVS-1459RT in safe mode does not launch the embedded LabVIEW Real-Time engine.

LED Error Indications

The NI CVS-1459RT indicates specific error conditions by flashing the STATUS LED a specific number of times. Refer to *STATUS LED* section of Chapter 2, *LED Indicators and the RESET Button*, for the STATUS LED indications.

PWR/FAULT LED Is Not Lit When the NI CVS-1459RT is Powered On

If the system power supply is properly connected (polarity is not reversed) to the NI CVS-1459RT, but the PWR/FAULT LED does not light up, check that the power supply is within the specifications outlined in the *NI CVS-1459RT Specifications*. Using a power supply that is not within these specifications might result in an unresponsive or unstable system and could damage the NI CVS-1459RT.

If the BIOS setting **Restore After Power Loss** is set to **Stay Off**, the NI CVS-1459RT may be powered, but turned off. Press the RESET button to power on the device.

B

Mounting Information

This appendix provides information for creating a custom mount for the NI CVS-1459RT. If you do not want to create a custom mount, a panel and DIN rail mount kit for the NI CVS-1459RT is available from National Instruments (part number 781740-01).

Figures B-1 through B-4 provide dimensional drawings and clearance information for the NI CVS-1459RT.

Caution If you choose not to mount the NI CVS-1459RT on a DIN rail or flat surface, do *not* position the NI CVS-1459RT with the heat sinks resting on any surface. Doing so may cause the NI CVS-1459RT device to overheat. Refer to the *NI CVS-1459RT Specifications* for temperature specifications.

Figure B-1. Front View of the NI CVS-1459RT with Dimensions in inches [millimeters]

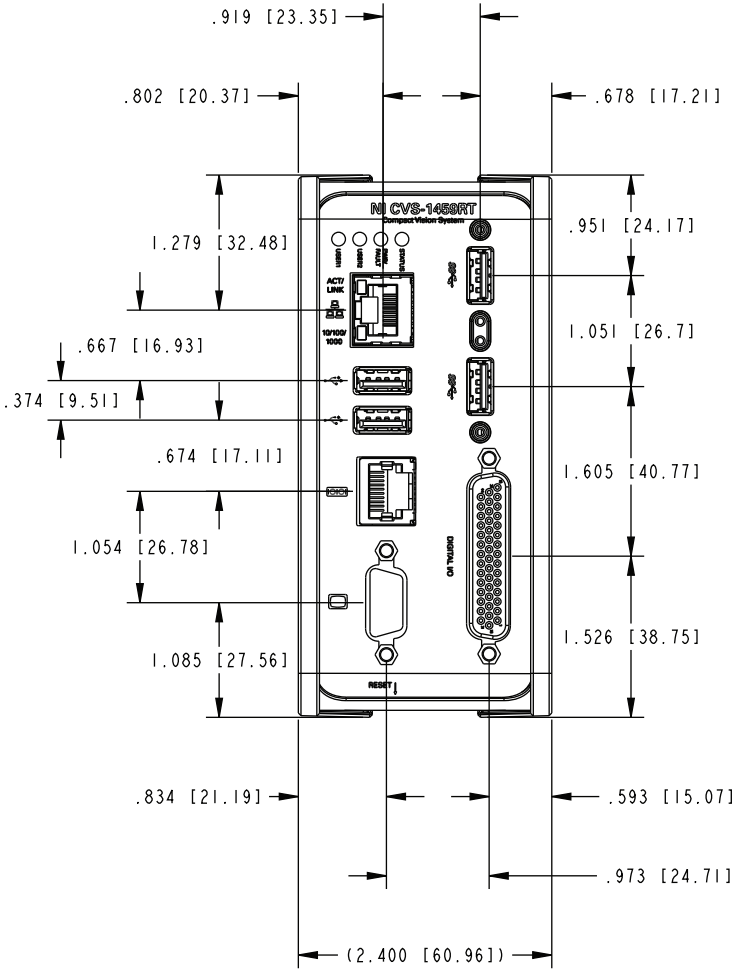
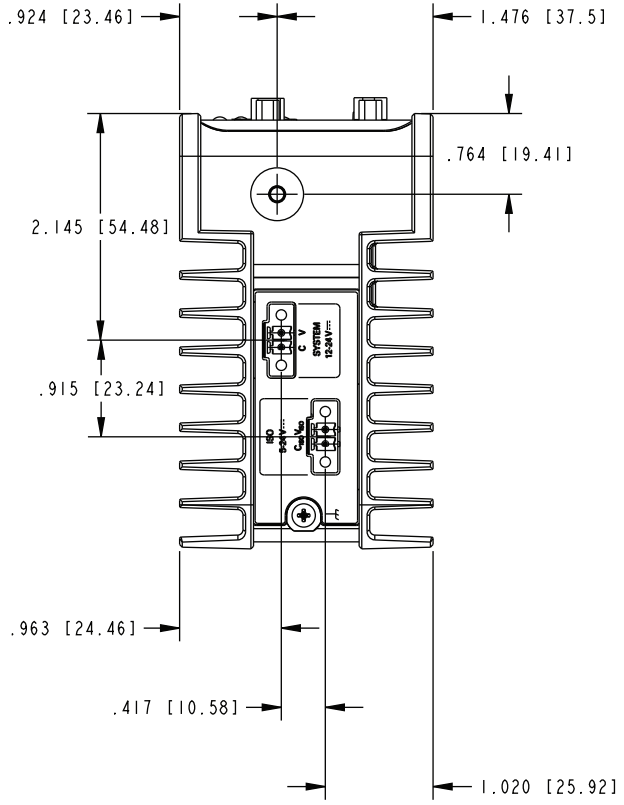


Figure B-2. Back View of the NI CVS-1459RT with Dimensions in inches [millimeters]



Note You can ground the NI CVS-1459RT to your mount by connecting a grounding wire to the chassis grounding screw on the NI CVS-1459RT. Refer to the *Chassis Grounding Screw* section of Chapter 3, *Connector Pinouts*, for more information about the chassis grounding screw.

Figure B-3. Side View of the NI CVS-1459RT with Dimensions

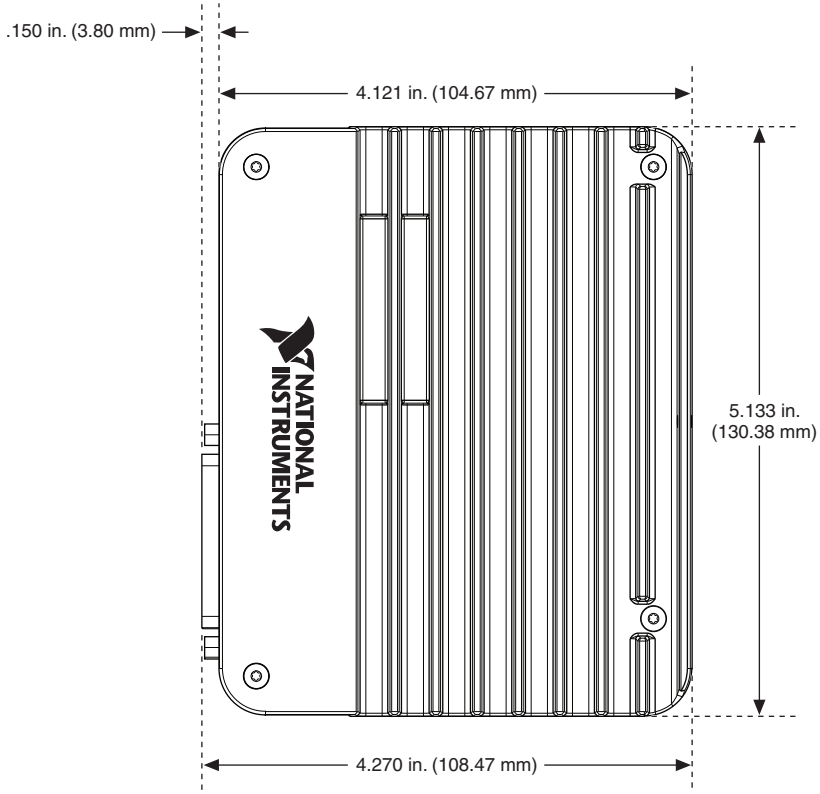
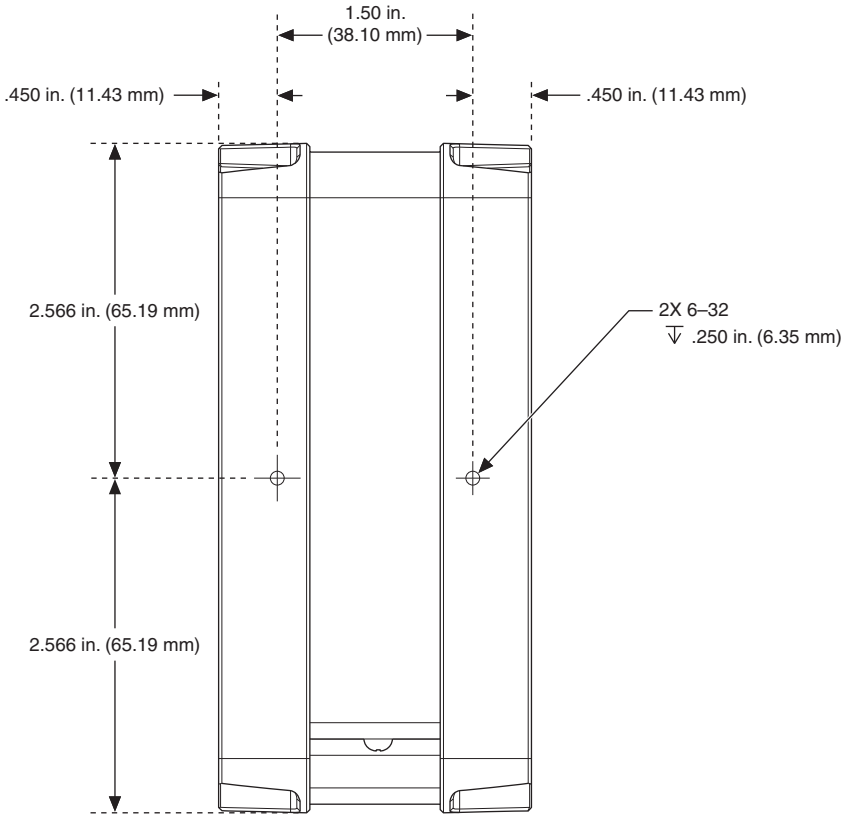


Figure B-4. Bottom View of the NI CVS-1459RT with Dimensions



Complete the following steps to secure the NI CVS-1459RT to a mount.

1. Align the screw holes of the mounting bracket with the two holes on the back of the NI CVS-1459RT.
2. Insert two 6-32 screws and tighten them until they are secure (3.5 in-lb). Make sure the heads of the screws are flush with the mounting bracket.

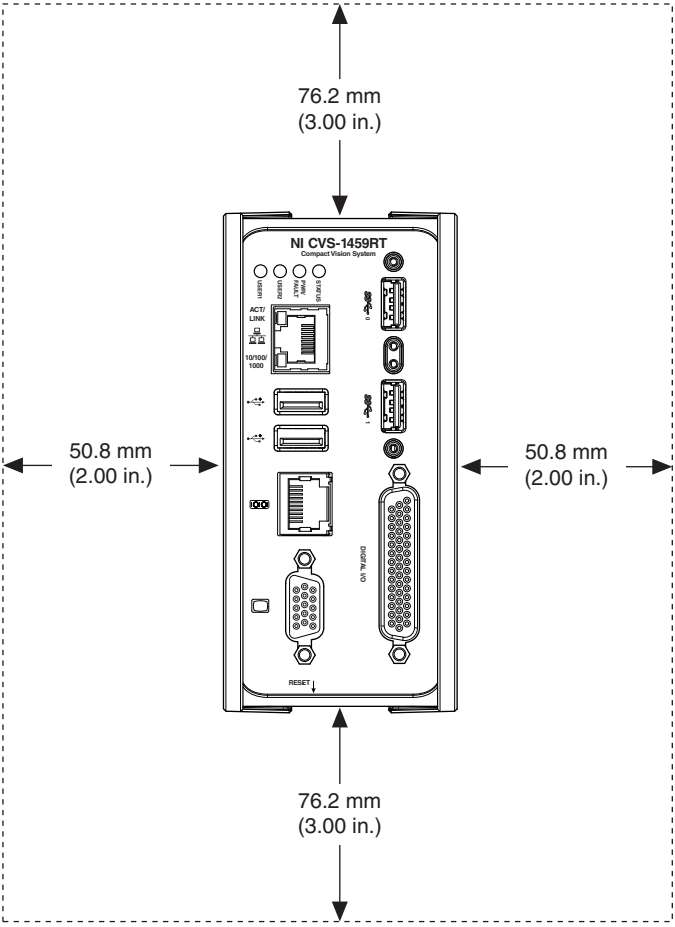
Clearance Requirements

The NI CVS-1459RT installation must meet the following space and cabling clearance requirements for optimum cooling:

- Allow 76.2 mm (3.0 in.) on the top and bottom of the NI CVS-1459RT for air circulation.
- Allow 50.8 mm (2.0 in.) on the sides of the NI CVS-1459RT for air circulation.
- Allow enough space in front of the NI CVS-1459RT to connect cables.

Refer to Figure B-5 for the clearance requirements for the NI CVS-1459RT.

Figure B-5. Clearance Requirements for the NI CVS-1459RT



C

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